00-D-103, Terascale Simulation Facility, Lawrence Livermore National Laboratory, Livermore, California

(Changes from FY 2000 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

The funding profile for this project has been changed and the project completion date has been pushed out one and a half years due to a change in the delivery schedule of the computer capabilities to be housed in the facility. The TEC and the TPC have been increased to reflect the additional escalation associated with the extension of the schedule.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 2000 Budget Request (*Preliminary Estimate*)	2Q 2000	2Q 2001	4Q 2000	4Q 2004	83,500	86,200
FY 2001 Budget Request *(Current Baseline Estimate*)	3Q 2000	3Q 2001	4Q 2001	2Q 2006	89,000	92,200

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
2000	7,970 [a]	7,970	3,500
2001	5,000	5,000	8,300
2002	26,000	26,000	25,200
2003	25,030	25,030	27,000
2004	20,000	20,000	15,600
2005	5,000	5,000	7,000
2006	0	0	2,400

3. Project Description, Justification and Scope

Description

The project provides for the design, engineering and construction of the Terascale Simulation Facility (TSF - Building 453) which will be capable of housing the 100 TeraOps-class computers required to meet the Accelerated Strategic Computing Initiative (ASCI). The building will encompass approximately 270,000 square feet. The building will contain a multi-story office tower with an adjacent computer

[a] Original appropriation was $8,000,000. This was reduced by $30,000 for the FY 2000 rescission enacted by P.L. 106-113.

center. The Terascale Simulation Facility (TSF) proposed here is designed from inception to enable the very large-scale weapons simulations essential to ensuring the safety and reliability of America's nuclear stockpile. The timeline for construction is driven by requirements coming from the ASCI within the Stockpile Stewardship Program (SSP). The TSF will manage the computers, the networks and the data and visualization capabilities necessary to store and understand the data generated by the most powerful computing systems in the world.

Justification

The Accelerated Strategic Computing Initiative has as its mission the acceleration of simulation to meet the demands of the nation's nuclear defense mission. The challenge is to maintain confidence in the nuclear stockpile without nuclear testing. Along with sub-critical experiments, one of the primary tools employed will be 3-D scientific weapons calculations of unprecedented computational scope. As has been emphasized in the ASCI Program Plan, it is the rapid aging of both the stockpile and the designers with test experience that is at the heart of the issue and the reason for acceleration. The most critical period is between 2003 and 2010. By 2003, the number of designers with test experience will be reduced by about 50 percent from their numbers in 1990. By 2010, the percentage will be further reduced to about 15 percent. By 2003, most of the weapons in the stockpile will be in transition from their designed field life to beyond field life design. By 2010, about half will be in the beyond-field-life design stage. Therefore some validated mechanism or capability must be available soon to certify the safety and reliability of this aging stockpile. A major element of this capability will be the ASCI applications codes and the associated terascale simulation environment. The ASCI program intends by the middle of the decade, to reach a threshold state simulation capability in which the first functional "full system calculation" generation of codes requiring a 100+ TeraOps computer will be used to certify the stockpile. The remaining designers and analysts with test experience will be an indispensable part of this process, because they will validate the models and early simulation results.

The ASCI applications codes and the weapons analysts who make use of these applications require a supporting simulation infrastructure of major proportions, which includes:

1. Terascale computing platforms (ASCI Platforms)
2. A supporting numerical environment consisting of data management, data visualization and data delivery systems (Visual Interactive Environment for Weapon Simulation or VIEWS)
3. Sophisticated computer science and numerical methods research and development teams (ASCI Problem Solving Environment (PSE) and Alliances)
4. A first rate operations, user services and systems team
5. Data and visualization corridor capability including data assessment theaters, high performance desktop visualization systems and other innovative technologies.

To house, organize and manage these simulation systems and services requires a new facility with sufficient electrical power, mechanical support, networking infrastructure and space for computers and staff. The proposed TSF at LLNL will meet these requirements.

Scope

The TSF project will construct a building (Building 453) of approximately 270,000 square feet located adjacent to an existing (but far less capable) computer facility, Building 451, on the LLNL main site. The building will contain a multi-story office tower with an adjacent computer center. The computer center will house computer machine rooms totaling approximately 47,500 square feet. The computer machine rooms will be clear span (without impediments) and of an aspect ratio designed to minimize the maximum distance between computing nodes and switch racks. The ceiling height will be sufficiently high to assure proper forced air circulation. A raised access floor will be provided in order to allow adequate room for air circulation, cabling, electrical, plumbing, and fire/leak detection equipment.

The first computer structure will be available for occupancy in FY 2004. The building will be initially built with enough power and cooling to support two terascale systems, the first to be installed in FY 2004. The computer center and electrical rooms will be designed so that power and cooling capacity can be shifted to areas requiring greater or lesser load. As a risk reduction strategy, the building will be further designed so that power and mechanical resources can be easily added in the event that systems sited in the future will require higher levels of power. However, it is expected that by the middle of the decade the rate of growth of the peak capability of installed computers will relax. Therefore, the building should have enough power and cooling to accept any system procured after that time.

The TSF will include meeting rooms, offices, and a data and visualization capability. Scientists will be able to utilize innovative visualization technologies, including an Assessment Theater. The theater will be used both for prototyping advanced visualization concepts and for ongoing data analysis and data assimilation by weapons scientists. In short, the theater represents the area where physical and computer scientists working together will visualize and make accessible to the human eye and mind the huge data sets generated by the computers. This will allow workers to understand and assess the status of the immensely complex weapons systems being simulated.

The office space will accommodate staff and scientists who require access both to classified and unclassified workstations. Vendors, operational and problem solving environment staff must have immediate access to computer systems, since the simulation environment will require very active support. A key principle underlying all TSF planning is tight coupling between Stockpile Stewardship Program elements and the platforms. Thus, the TSF will also house the nucleus of the classified and unclassified (LabNet) networks. To assure the efficient operation of remote Assessment Theaters high speed networking hubs will connect the computers seamlessly to key weapons scientists and analysts at the highest performance available.

Project Milestones

FY 2000:	Start Design	3Q
FY 2001:	Complete Title II Design	3Q
	Start Construction	4Q

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (Design Drawings and Specifications – $3,800)	5,050	4,715
Design Management Costs (0.8% of TEC)	750	530
Project Management Costs (0.7% of TEC)	600	530
Total Design Costs (7.2% of TEC)	6,400	5,775
Construction Phase		
Improvements to Land	2,100	1,700
Buildings	47,850	46,505
Utilities	10,600	10,400
Standard Equipment	1,500	1,255
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	3,800	2,940
Construction Management (3.8% of TEC)	3,400	2,655
Project Management (1.9% of TEC)	1,650	1,490
Total Construction Costs (79.7% of TEC)	70,900	66,945
Contingencies		
Design Phase (1.1% of TEC)	1,000	900
Construction Phase (12.0% of TEC)	10,700	9,880
Total Contingencies (13.1% of TEC)	11,700	10,780
Total, Line Item Costs (TEC) [a]	89,000	83,500

5. Method of Performance

Design shall be performed under a negotiated Best Value architect/engineer contract. Construction and procurement shall be accomplished by fixed-price contracts based on competitive bidding and best value award.

[a] Escalation rates taken from the FY 2001 DOE escalation multiplier tables dated January, 1999.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1999	FY 2000	FY 2001	Outyears	Total
Project Cost						
Facility Costs						
Design	0	0	3,500	3,200	700	7,400
Construction	0	0	0	5,100	76,500	81,600
Total, Line item TEC	0	0	3,500	8,300	77,200	89,000
Total Facility Costs (Federal and Non-Federal)	0	0	3,500	8,300	77,200	89,000
Other Project Costs						
Conceptual design costs	500	800	0	0	0	1,300
NEPA documentation costs	0	150	0	0	0	150
Other project-related costs [a]	410	520	0	0	820	1,750
Total, Other Project Costs	910	1,470	0	0	820	3,200
Total Project Cost (TPC)	910	1,470	3,500	8,300	78,020	92,200

7. Related Annual Funding Requirements

(FY 2006 dollars in thousands)

	Current Estimate	Previous Estimate
Annual facility operating costs [b]	1,500	1,400
Programmatic operating expenses directly related to the facility [c]	56,200	53,100
Utility costs [d]	8,500	8,000
Total related annual funding (operating from FY 2006 through FY 2025)	66,200	62,500

[a] Including tasks such as Project Execution Plan, Pre-Title I Development, Design Criteria, Safeguards and Security Analysis, Architect/Engineer Selection, Value Engineering Study, Independent Cost Estimate, Energy Conservation Report, Fire Hazards Assessment, Site Surveys, Soil Reports, Permits, Administrative Support, Operations and Maintenance Support, ES&H Monitoring, Operations Testing, Energy Management Control System Support, Readiness Assessment.

[b] Facility operating costs are approximately $ 1,500,000 per year (which also includes facility maintenance and repair costs), when facility is operational in 4th Qtr. FY 2006. Costs are based on the LLNL internal indirect rate Laboratory Facility Charge (LFC) for facility operating costs.

[c] The annual operating expenses for the Terascale Simulation Facility are estimated at $ 56,200,000 based on representative current operating expenses of 300 personnel. The majority of this funding is expected to come from DOE/DP for activities in support of the Nuclear Weapons Stockpile Stewardship Program.

[d] Costs are based on LLNL utility recharge rates.